Eastman Gelatine Corporation
Wastewater Treatment System
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W201578

OPERATING GUIDELINES

General: Wastewater discharges from manufacturing are split into 3 separately sampled streams; indoor basin (high flow, low BOD/TSS, variable pH), Liming operations (low flow, high BOD/TSS, high pH) and Osseine (low flow, high BOD/TSS, low pH). Liming and Osseine flows normally get 100% treatment through the secondary system while flows from the indoor basin (NBE) may receive 0-100% treatment.

pH: The pH from the indoor basin will range from 2-12 units and requires pH adjustment for either treatment or bypass. The pH from Osseine averages between 5-6 units and receives no treatment**,** while the pH from liming averages between 11-12.5 units and must be partially neutralized prior to treatment.

Flow: Combined average flows from the 3 streams range from 1.7 MGD to 2.5 MGD. Maximum flows may exceed 3.0 MGD during wet weather events and will require control to avoid overloading the 90' clarifier and the resulting spill over and/or TSS loss to South Essex Sewerage District (SESD). Average flows pose little threat to the process unless upset conditions (poor bio-health/high SVI's) result in high TSS loss to SESD.

TSS: Untreatable TSS (inorganic solids) will add to the MLSS and normally do not pose a threat to the process unless the MLVSS/MLSS ratio is less than (50%). Organic solids are treatable and pose no threat to the process.

OVERALL PROCESS CONTROL

Sampling: Daily 48 hour time or flow composite samples from each influent stream are to be collected at midnight daily. A 1 liter composite of the 3 samples needs to be prepared for analysis. Routine analyses include:

- pH adjusted TSS
- BOD
- Other as necessary

Individual analysis on each sample should be conducted monthly to identify any major changes in wastewater characteristics.

Osseine (Pump House # 12/17): Normal operation is via pumphouse #12 which flows directly to the mix zone. A flow meter with totalizer records flow to manage secondary loading. The #12 pumphouse has a capacity of 1200 gpm. Normal (dry-weather) flow of 300 gpm and wet-weather flows exceeding 600 gpm should receive full secondary treatment. Pumphouse #17 is used as backup and flows to the neutralization process (NB) via a separate pipeline. In addition, pumphouse #12 has separate back-up pumps discharging to the equalization tank (EQ tank).

Liming (60' clarifier pump pit): Normal operation directs all flow to secondary for treatment. The EQ tank flow meter is used to measure liming flow and includes a totalizer. Acid is added at the discharge of the 60' clarifier and controlled by the PLC. The pH to the mix zone is controlled to maintain a pH in the aeration basins of between 6.25 and 6.6 standard units. This will prevent the precipitation of inorganic solids in the secondary treatment process. Several automated control alternatives are available for acid addition. The 60' clarifier pump pit may also be directed to the NB utilizing the bypass valve in the valve pit just outside the pump pit.

Indoor Basin (NBE pump): Normal operation will pump the majority of the flow to secondary treatment with the remainder overflowing without treatment to SESD. Several variables need to be considered in determining how much NBE flow to pump to secondary treatment;

Variable	Lower NBE Flow	Higher NBE Flow
Total flow to secondary	> 3.0 MGD	< 3.0 MGD
90' TSS	> 100 ppm	< 100 ppm
DO	< 1.0 ppm	> 2.5 ppm
Indoor basin TSS/BOD	< 50 ppm	> 300 ppm
Effluent TSS (SESD)	N/A	> 5000 #/day
MLSS	> 12000 ppm	< 12000 ppm
Filter press availability	Above capacity	Below capacity

Flow control for the NBE pump can be accomplished via several automated PLC control alternatives. Determination of the best flow rate is dependent on several leading/lagging indicators as listed in the table above. Additional considerations include general bio-health.

MIX ZONE

Operating Guidelines:

The purpose of the mix zone (anoxic zone) is to premix the flows from RAS, NBE, pumphouse #12 and the 60' clarifier pump pit. MLSS from the jet aeration recirculation pumps provide adequate energy to mix the 4 feed streams prior to aeration. This mixing energy ensures dilution/buffering of the low and high pH streams. This zone is operated anoxically, to provide for denitrification and filament control.

Process Control:

Air Management: No air is added to the mix zones at this time. The mix zones are operated anoxically. This has shown to provide filament control and helps to maintain dissolved oxygen levels in the aerators through utilization of oxygen from the denitrification process to break down BOD.

pH: Proper pH control of the 60' clarifier pump pit and the NBE plus adequate mixing energy ensures the pH in the mix zone of the combined waste streams, MLSS and RAS will be in the 6.25 - 6.60 units range. Periodic checks of the mix zone pH should be conducted if the pH in the aeration tanks is greater than 7.2 units.

AERATION BASIN

Operating Guidelines

Oxygen Demand: The activated sludge process converts organic material (BOD loading) to CO2 via bacterial respiration and to generate new bio-solids via growth of new bacteria. The respiration process requires addition of oxygen to the wastewater via the jet aeration system. Bio-solids and inorganic TSS combine to form the MLSS (biomass) which converts the BOD/NOD to CO2/NO2(3). In addition, various waste streams contain significant amounts of ammonia and organic nitrogen (NOD) which will nitrify and add to the oxygen demand of the aeration system. Flow control may be required to limit the oxygen demand on the activated sludge process**,** resulting in bypass of untreated wastewater.

Toxic Conditions: Normal pH control minimizes the risk of significantly altering the pH in the aeration basins. The volume of the aeration tanks, the high buffering capability of the mixed waste streams**,** and the biological process will resist any major pH swings of the MLSS**.**

Nutrients: Nitrogen and phosphorus are required for the growth of desired microorganisms. Lack of appropriate nutrients may result in inhibited growth or growth of undesirable microorganisms as filaments. The wastewater at EGC normally has ample supply of both nitrogen and phosphorus and should not pose a threat to good operation of the activated sludge process. Note: in order for phosphorus to be available the pH in the aerators must remain below 7.0 units.

Process Control

MCRT: Mean Cell Residence Time (MCRT), also known as sludge age, identifies the amount of time (days) which the biomass resides in the process (mixing zone, aeration basin, clarifier) before being removed, or wasted, from the process. A spreadsheet calculates the amount of biomass to be wasted (WAS) in order to maintain the desired MCRT. Management of the MCRT is included as a key process variable (KPV) for managing the activated sludge process. Operation at a prescribed MCRT dictates the variety of microorganisms which will populate the biomass and the growth of new microorganisms. Significant deviation from the prescribed MCRT over a period of days to weeks may result in a shift in microorganisms. This may be accompanied by a reduction in BOD removal, increased loss of TSS from the 90' clarifier, increased floating solids in the 90' clarifier, foaming in the mixing zone and aeration tanks, a change in nitrification/denitrification, growth of filaments and an increase (higher MCRT) or decrease (lower MCRT) in the MLSS.
Note: Normal range for the MCRT aim at EGC is 5-10 days.
WAS: Waste Activated Sludge (WAS) identifies the flow rate of the settled MLSS removed from the 90' clarifier and sent to the filter press operations for dewatering. The WAS rate is calculated as a function of desired MCRT, WAS TSS concentration**,** and 90'clarifier effluent TSS.
DO control/Air Management: Air flow required to maintain adequate DO levels can be accomplished via several automated programmable logic controller (PLC) control alternatives. DO levels ranging from 1.0 - 3.0 ppm are adequate for good bio-health and BOD/NOD removal performance. Potential consequences of operating outside the desired range are listed below:

DO's > 3.0 ppm	**DO's < 1.0 ppm**
Higher energy use	Growth of filaments
Increased foaming	Increased SVI's
Toxic situation (inhibited oxygen uptake)	Decreased BOD removal
Dead biomass	Decreased biomass diversity
	Increased denitrification in clarifier

With the relatively high plant BOD loading normally encountered, operation of the air supply system is typically at maximum. Several control alternatives have the 'maximum amp lock feature'. Operation at DO's below 1.0 ppm for prolonged time periods (>8 hours) should be avoided by reducing flow to the secondary process. The following are recommended alternatives depending on plant conditions:

Reduce NBE flow by 25 - 50%
Reduce flow from EQ tank by 25 - 50%

Note that reducing flows by either method will not have an immediate impact on DO's. It may take several hours before DO's start to increase.
Bio-Health: Frequent plant observations, including analysis of aeration basin influent, process control variables, 90' clarifier effluent and total plant control bio-health. Microscopic exams are performed if SVI's indicate a problem.

1. SVI**:**

SVI	**Low value**	**High value**
Normal range	50	150
Concern range	40 - 50	150 - 300
Low	< 30	N/A
High		> 300

If SVI's persist in the high value 'concern range' for greater than 5 days or if 'high' SVI's are present, samples should be sent for microorganism analysis. Operation at low value 'concern range' or 'low' SVI's are not as great a concern. Probable cause is excessive inorganic solids and the MLVSS should be checked. RAS chlorination as described below may be used to reduce the filamentous bacteria.

2. Microscopic Exams: MLSS from each aeration basin should be checked periodically for variety of microorganisms and abundance of filaments.

3. Microorganism Exams: Samples of MLSS need to be shipped to the external lab per schedule. Data should be analyzed upon receipt and compared to previous data for trending and corrective action if required.

pH control: pH is provided on the PLC for each aeration tank. Normal pH, between 6.25 - 6.60 units, is controlled by the amount of hydrochloric acid added to the 60' effluent and / or the neutralization basin.

Probable causes of low pH (< 6.25 units): nitrification, loss of 60'/liming discharge, low pH from the NB or an acid spill.

Probable causes of high pH (> 6.60 units): denitrification, loss of PH #12/Osseine discharge, lack of pH control in the NB or 60'/liming discharge or a lime spill.

If aeration basin pH is above/below the acceptable range, check the pH in the mix zone, evaluate operation of all pH control loops and check the operation/pH of all pump pits. Correct any deficiencies found and continue to monitor mix zone pH every 4 hours until normal readings are attained. (Note: It will take 5-10 hours to see a pH change in the aeration tank. Mix zone pH will change within 1-2 hours) If nitrification/denitrification is the cause, it will self correct within 1-3 days. Other corrective actions include chlorination of return sludge to kill the nitrifiers.

90-FOOT CLARIFIER

Operating Guidelines:

The primary purpose of the 90' clarifier is to remove solids from the wastewater and thicken solids to either return to the mix zone (RAS) or waste to the filter presses (WAS). Functionality of this process is very dependent on flow rate, solids loading ratio (SLR) on the clarifier, settleability (SVI) of the MLSS and mass of solids (blanket level) in the clarifier. Good performance of the unit should produce an effluent TSS of <65 ppm (40-60 ppm is normal) with a RAS/WAS TSS of 1.5 - 2.0 x (MLSS).

Process Control:

RAS: Return Activated Sludge (RAS) identifies the flow rate at which the settled MLSS is removed from the bottom of the 90' clarifier via 3 'pick-up' tubes on each arm, flows to the RAS sump**,** and returns to the mixing zone. Each 'pick-up' tube has a flow control adjustment in the RAS sump. Normal adjustment requires 100% flow from the outside (left) tubes with reduced flow (50-75%) for the center tube and 25-50% flow for the inside (right) tube. Adjustments keep the sludge blanket lower towards the outside (overflow) area of the clarifier reducing TSS loss to the effluent. Lower flows on the inner tubes will help maximize the WAS TSS concentration. A spreadsheet records the RAS rate. RAS rates also impact the mass loading on the clarifier and the Hydraulic Detention Time (HDT) in the aeration process. The total flow to aeration (Total influent flow + RAS flow) multiplied by the MLSS determines the solids loading on the clarifier. The RAS rate depends on the SVI, presence of denitrification, RAS/WAS TSS concentrations**,** and blanket levels. The following data needs to be considered when establishing RAS rates;

Parameter	Lower RAS (800-1200 gpm)	Higher RAS (1200-1750 gpm)
Blanket level	**< 4 feet**	**> 4 feet**
SVI	**< 100 units**	**>100 units**
Denitrification		**Rising sludge in 90' clarifier**
RAS/WAS TSS	**< 2 X MLSS**	

RAS Chlorination: The addition of Sodium Hypochlorite (NaOCl) may be used to reduce high SVI's if filaments are the cause. This 'reactive' solution is best accomplished by adding a 15% solution of NaOCL to the clarifier spray system with the solution directed to the RAS sump. Addition rates of roughly 3-8 gal/hr of 15% NaOCl are recommended depending on the SVI's and RAS rate:

SVI's > 150 units ----- 6-8 gal/hr.

SVI's -100 - 150 units-- 3-6 gal/hr.

Residual Total Chlorine at the RAS discharge should be no greater than 0.5 - 1.5 ppm. Observations should include chlorine order (none) at the mix zone, 90' effluent turbidity (some increased turbidity is normal) and DO's. If an abnormal increase in DO’s occurs, check dosage of NaOCl and reduce as necessary.

Scum removal: Excessive foaming may require manual removal of scum on the clarifier inlet/aeration tanks to avoid loss of TSS in the 90' effluent. Normal levels of scum on the 90' clarifier are managed automatically by the 'scum scoop' and scum rake mechanism. Note this material is normally returned to the mix zone via the RAS line and will reduce the amount of RAS pumped. An alternative is to direct the scum to the filter presses via the WAS line.

90-FOOT CLARIFIER EFFLUENT

Operating Guidelines:

Flow: The discharge from the 90' clarifier normally represents between 75 - 100% of the flow going to SESD depending on the per-cent bypassed.

pH: The pH of the effluent is primarily controlled by the biological processes operating in the aeration tanks and clarifier and should produce a well buffered discharge just above the lower pH limit of 6.5 units.

TSS: The effluent TSS should normally range between 30 - 65 ppm.

BOD: The effluent BOD should normally range between < 10 - 25 ppm.